

Claims

1. Apparatus comprising
a power converter comprising electrical contacts arranged on a first surface, the converter having a top surface above the first surface and a bottom surface below the first surface, a border of the bottom surface being inset from a border of the second surface,
a connection device comprising a pair of conductive legs, each leg comprising a first end and a second end, the pair of legs lying opposite each other in a pair of evenly spaced planes that intersect the first surface,
the first ends adapted to connect to one or more of the contacts on the first surface and the second ends adapted to connect to one or more conductive pads on a surface of a substrate,
the connection device being adapted to enable the first ends of the two legs to connect to the contacts from below the first surface.
2. The apparatus of claim 1 wherein the first ends and second ends of respective legs are spaced apart by a distance that is greater than a distance between the first surface and the bottom surface.
3. The apparatus of claim 1 wherein the top and bottom surfaces are planar and are parallel to each other and to the first surface.
4. The apparatus of claim 1 wherein the electrical contacts are part of a ball-grid array.
5. The apparatus of claim 1 wherein the conductive pads comprise conductive etch.
6. The apparatus of claim 1 comprising two or more pairs of legs in the pair of planes.
7. The apparatus of claim 1 wherein the pair of legs are part of a strip of conductive material bent to form the pair of legs, each leg connected at a right angle to a spanning portion of the strip, the pair of legs being electrically connected together by the spanning portion.
8. The apparatus of claim 7 wherein the spanning portion comprises the first ends of each of the two pair of legs.

9. The apparatus of claim 1 wherein the legs of the pair are formed from separate pieces of conductive material.

10. The apparatus of claim 1 wherein the second end of each leg is formed into a J.

11. The apparatus of claim 10 wherein the J end of each leg is directed inward toward the other leg so that the two ends of the Js lie between the pair of legs.

12. The apparatus of claim 1 comprising two or more pairs of legs held together by a non-conductive rib.

13. The apparatus of claim 12 wherein the rib comprises a hole that exposes a portion of a pair of legs to form a first end.

14. The apparatus of claim 12 wherein each of the pairs of legs comprises a strip of conductive material bent to form the pair of legs, each leg connected at a right angle to a spanning portion of the strip, the pair of legs being electrically connected together by the spanning strip, and wherein the rib comprises a hole that exposes a portion of the spanning strip to form a first end.

15. The apparatus of claim 14 wherein the legs of a pair is formed from separate pieces of conductive material and wherein the rib comprises holes that expose a portion of each leg to form a first end.

16. The apparatus of claim 15 wherein the rib connects the pairs of legs so that the legs lie in the pair of planes.

17. A method for making connections between (a) electrical contacts that are inset from a bottom surface of a power converter and (b) conductive pads located on a substrate, the method comprising

interposing between the contacts and the bottom surface, conductive segments that comprise two generally parallel conductive legs, each leg comprising a first end and a second end, the first ends of the two legs being connected to one or more of the electrical contacts and the second ends extending to a location below the bottom surface and connecting to one or more of the pads.

18. The method of claim 17 further comprising,
providing additional conductive segments, each conductive segment comprising pairs of generally parallel legs, and

arranging the segments in a row using a non-conductive rib so that the generally parallel legs in each segment lie in two generally parallel planes.

19. The method of claim 19 further comprising,
providing a ball-grid array of electrical contacts on the power converter;
providing holes in the rib to expose portions of first ends at locations along the rib that align with the locations of the balls in the ball-grid array, and
soldering the ball-grid array to the exposed locations of the spanning portions.

20. The method of claim 17 further comprising folding the free ends of the legs into a J, and soldering the J-shaped portions of the free ends to the conductive pads on the substrate.

21. The apparatus of claim 2 wherein the distance is essentially equal to the maximum distance between the first surface and the bottom surface so that the bottom surface is just above, and in close proximity to, the surface of the substrate.

22. The apparatus of claim 2 wherein the distance is greater than the maximum distance between the first surface and the bottom surface so that a gap exists between the bottom surface and the surface of the substrate .

23. The apparatus of claim 21 wherein the distance is twice the value of the maximum distance between the first surface and the bottom surface.